PETROLOGY AND GEOCHEMISTRY OF NEW PAIRED MARTIAN METEORITES LARKMAN NUNATAK 12240 AND LARKMAN NUNATAK 12095.

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Introduction: Two of the latest Martian meteorites found in Antarctica, paired olivine-phyric shergottites LAR 12240 and LAR 12095, are described in order to decipher their petrological context, and place constraints on the geological history of Mars. This project identifies all phases found in LAR 12240 and 12095 and analyzes them for major and trace elements. The textural relationships among these phases are examined in order to develop a crystallization history of the magma(s) that formed these basalts.

Methods: Two polished, 100 µm thick sections of the paired Martian meteorites LAR 12240 and LAR 12095 were examined with a petrographic microscope and imaged by a scanning electron microscope (SEM). Major elements were analyzed by an electron microprobe and trace elements by a laser ablation inductively coupled plasma mass spectrometer.

Results and Discussion: LAR 12095 and LAR 12240 are typical olivine-phyric shergottites [1] with Mg-rich olivine megacrysts in a matrix comprised of pyroxene, smaller Fe-rich olivines and interstitial plagioclase (which has all been transformed by shock processes to maskelynite). Based upon the comparison of the bulk-rock compositions of LAR 12095 and LAR 12240 to their most Mg-rich olivine megacryst cores (Fo_{75}), as well as the textural context of the megacrysts, it is inferred that the olivine megacrysts are antecrysts and about 35% olivine accumulation is calculated. The olivine megacrysts in LAR 12095 and LAR 12240 contain numerous melt inclusions which may provide snapshots of the magma composition at early stages of the crystallization. The initial compositions of the melt inclusions have been re-calculated to account for Fe-loss to the surrounding olivine and are more evolved than the bulk-rock compositions of LAR 12095 and LAR 12240 or compositions of shergottite parent magmas from the literature. The crystallization of LAR 12240 and LAR 12095 likely began with the crystallization of Cr-rich spinels and the Mg-rich olivine megacryst cores. Then less Cr-spinels likely began crystallizing along with the outer edges of the olivine megacrysts and pigeonite. The olivine megacrysts were then entrained in a magma that crystallized at or near the Martian surface. The magma kept crystallizing spinels along with 0.5-1 mm and 0.1 mm sized Fo_{60} olivines and the last of the pigeonite. As the Fo_{60} olivines and the last of the pigeonite were crystallizing, augite would have also begun crystallizing. Plagioclase feldspar, ulvöspinel and sulfides finally crystallized forming the groundmass of both LAR 12240 and LAR 12095. The last phase to crystallize would have been merrillite. The MELTS software [2,3] was used to model the crystallization of LAR 12095 using the calculated bulk-rock composition as a starting composition. The first phase to crystallize in the MELTS computation was olivine. Olivine crystallized from 1467ºC to 1097ºC and its composition ranged from Fo_{63-88}. Pyroxene crystallized from 1447ºC to 1097ºC and its composition ranged from $En_{60-88}Fs_{11-28}Wo_{1-12.}$ Spinel crystallized from 1457ºC to 1097ºC and its composition ranged from 38-58% chromite, 3-5% magnetite, 27-38% spinel and 1-30% ulvöspinel. Feldspar crystallized from 1147ºC to 1097ºC and its composition ranged from An_{39-54}. Whitlockite crystallized from 1207ºC to 1097ºC and was the last phase to crystallize in the MELTS computation. While this MELTS computation does not exactly produce LAR 12240 and LAR 12095, it has strong similarities to the crystallization scenario inferred from the textures and compositions of LAR 12240 and LAR 12095. The REE patterns of all of the phases of LAR 12240 and LAR 12095 as well as that of the calculated bulk-rock composition of LAR 12095 have depleted LREE patterns that place these meteorites in the depleted shergottite group (La/Yb < 0.3) [4,5,6,7] . Spinel-pyroxene-olivine associations have been analyzed for major elements in order to calculate the oxygen fugacity (fo_2) evolution of the basalts during their crystallization. The calculated fo_2 found in LAR 12240 and LAR 12095 range from ΔFMQ -2.7 to -1.9. These values are all on the low end of the range of shergottite fo_2 values (ΔFMQ -2.5 to -.9) and place LAR 12095 and LAR 12240 into the reduced shergottite group [5,8,9,10]. LAR 12095 and LAR 12240 most closely resemble Sayh al Uhaymir 005 for their major and trace element compositions. These meteorites also closely resemble Dar al Gani 489 for trace element compositions.

References: [1] Goodrich C.A. 2002. *MAPS* 37:B31-B34. [2] Gualda G.A.R. et al., 2012. *J PETROL* 53:875-890. [3] Ghiorso M.S. and Gualda G.A.R. 2015. *CONTRIB MINERAL PETR*, in press. [4] Wadhwa M. et al., 2001a. *MAPS* 36:195-208. [5] Borg L.E. et al., 2002. *GCA* 66:2037-2053. [6] Herd C.D.K. 2002. *GCA* 66:2025-2036. [7] Symes S.J.K. et al., 2008. *GCA* 72:1696-1710. [8] Wadhwa M. 2001b. *Science* 291:1527-2530. [9] Herd C.D.K. 2003. *MAPS* 38:1793-1805. [10] McCanta M.C. et al., 2004. *GCA* 68: 1943-1952.